Declaration

I, a national of Japan, c/o A. WATANABE & ASSOCIATES of 1-20-10-203, Takadanobaba, Shinjuku-ku, Tokyo 169-0075, Japan, do hereby solemnly and sincerely declare:

1) THAT I am well acquainted with the Japanese language and English language, and

2) THAT the attached is a full, true, accurate and faithful translation into the English language made by me of Japanese Text of the U.S. Serial No. 09/726,507

The Undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001, of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Singed this 27th day of March, 2003.

Masaaki Utsunomiya

Masaaki UTSUNOMIYA
Patent Attorney

【Document Name】 Patent application

【Reference Number】 88-7475

【To】 Commissioner of Japanese Patent Office

【I.P.C.】 G02B 26/00

【Inventor】

【Address】 c/o Fuji Photo Film CO., LTD.
798, Miyanodai, kaisei-cho, Ashigarakami-gun, Kanagawa-ken (JP)

【Name】 HARADA, Akinori

【Applicant】

【Identification Number】 000005201

【Address】 210, Nakanuma, Minamiashigara-shi, Kanagawa-ken (JP)

【Name】 FUJI PHOTO FILM CO., LTD.

【Agent】

【Identification Number】 100100413

【Patent Attorney】

【Name】 WATANABE, Atsushi

【Identification of Fee】

【Deposit Account Number】 033189

【Fee】 21,000 yen

【List of Filed Documents】

【Document Name】 Specification 1

【Document Name】 Drawing 1

【Document Name】 Abstract 1

【General Power of Attorney Number】 9909552

【Proof】 Yes

【Document Name】 Specification

【Title of the Invention】 PLATE-MAKING METHOD AND PLATE-MAKING APPARATUS

【CLAIMS】

【Claim 1】 A plate-making method comprising the steps of:

preparing a photosensitive plate-making material;

scanning said photosensitive plate-making material by using modulated laser light so as to record an image on said photosensitive plate-making material;

developing the image, wherein:

said laser light includes ultra-short pulse laser light which causes photopolymerization reaction by a two photon absorption phenomenon at a laser-light-irradiated portion of said photosensitive plate-making material.

【Claim 2】 A plate-making method according to claim 1 wherein:

a pulse width of said ultra-short pulse laser light is not longer than 10ps.

【Claim 3】 A plate-making method according to claim 1 wherein:

a wavelength of said ultra-short pulse laser light is not longer than 800nm; and

a photosensitive wavelength of said photosensitive plate-making material is not longer than 400nm.

【Claim 4】 A plate-making method according to claim 1 wherein:

said photosensitive plate-making material includes a

photosensitive layer made of photopolymer on a supporting member.

【Claim 5】 A plate-making apparatus for scanning a photosensitive plate-making material by using modulated laser light to record an image on said photosensitive plate-making material, comprising:

a light source for generating laser light including ultra-short pulse laser light which causes photopolymerization reaction by a two photon absorption phenomenon at a laser-light-irradiated portion of said photosensitive plate-making material;

a light modulator; and

a light scanning mechanism.

【Claim 6】 A plate-making apparatus according to claim 5 wherein:

a pulse width of said ultra-short pulse laser light is not longer than 10ps.

【Claim 7】 A plate-making apparatus according to claim 6 wherein:

a wavelength of said ultra-short pulse laser light is not longer than 800nm; and

a photosensitive wavelength of said photosensitive plate-making material is not longer than 400nm.

【Detailed Description of the Invention】

【0001】

【Field of the Invention】

The present invention generally relates to a method

and an apparatus for forming a printing plate used in a planographic printing operation and the like. More specifically, the present invention is related to such a plate-making method etc. capable of recording a sharp image without being adversely influenced by laser flare, and also applicable to a process operation executed in a light room. Furthermore, the present invention is directed to a plate-making apparatus used in a plate making method, and an image recording material such as a photosensitive plate-making material.

【0002】

【Prior Art and Problem to be solved by the invention】

While a CTP (computer-to-plate) plate-making system (will be simply referred to as a "CTP system" hereinafter) is employed as an example, conventional techniques of plate-making methods will now be described. This CTP system corresponds to such a system that while image information stored in a computer is recorded on a photosensitive plate-making material by using a laser scanner and the like, the recorded image is developed to form a printing plate. In this CTP system, printing intermediate films with respect to the respective colors employed in the known photolithography process is no longer required. As a result, this CTP system may constitute a considerably attractive system having such various merits, for instance, low cost, high-speed processing, and high image qualities.

【0003】

Very recently, two different types of photosensitive plate-making materials, namely, 1) high-sensitivity photopolymer plate-making material and 2) thermal photosensitive plate-making material, have been positively developed in this CTP system in conjunction with great progresses of laser light sources used to expose these plate-making materials. In the current CTP systems with employment of the above-explained photosensitive plate-making materials, the below-mentioned problems may occur:

【0004】

1) a CTP system with employment of the above-explained high-sensitivity photopolymer plate-making material:

Normally, this CTP system employs as exposure light, laser light having power of approximately 100mW to 200mW and having wavelengths from UV (ultraviolet) to blue/green, which is produced from either an Ar^+ laser or an LD-excited green solid-state laser. This CTP system may have merits of processing/printing aptitude similar to those of the conventional system using the PS (Pre-Sensitized) plate corresponding to the photosensitive plate-making material.

However, in this CTP system, since the laser light having the wavelengths from UV to blue/green and the high sensitive photopolymer are employed, the adverse influences of the laser flares are apt to be caused by laser light scattering phenomenon, laser light reflections, and laser light diffraction, which occurred in the optical system and the photosensitive planes.

As a result, the resultant image qualities may be easily deteriorated. Also, in the case that the laser light of blue/green color is employed as the exposure light, both the exposure process and the developing process of the plate are required to be performed in a dark room. Namely, darkroom process operation is required.

【0005】

2) a CTP system with employment of the above-described thermal photosensitive plate-making material:

A thermal photosensitive plate-making material is classified into both a thermal/negative photosensitive plate-making material and a thermal/positive photosensitive plate-making material. Since these photosensitive plate-making materials own very low sensitivities, these plate-making materials are not photosensitized by the normal illumination light, although high power laser light in the class of 1W to 10W must be irradiated to these very low sensitive plate-making materials. Therefore, these photosensitive plate-making materials can be handled in a light room.

However, since a very large oven is necessarily required in a pre-heat stage with respect to such a thermal/negative photosensitive plate-making material, a processing system thereof becomes bulky. Furthermore, this thermal/negative photosensitive plate-making material owns another problem that a latitude or a permissible range with respect to a heating temperature in a heating stage is narrow, and also very cumbersome temperature controls are necessarily required.

On the other hand, in the case that a thermal/positive photosensitive plate-making material is employed in the CTP system, although a heating stage is not required, there is such a problem that a latitude of a developing process is narrow and also very strict management is required with respect to the developing conditions. Further, these two thermal photosensitive plate-making materials own a certain drawback as to stability for a long time period.

【0006】

The present invention has been made to solve the above-explained problems, and therefore, has an object to provide a plate-making method etc. capable of recording a sharp image on a photosensitive material, while an adverse influence caused by laser flare can be hardly given, and also capable of being applied to a process operation executed in a light room.

【0007】

【Means for Solving the Problems and Embodiments of the Invention】

To solve the above-described problems of the prior art, a plate-making method according to the present invention comprises the steps of: preparing a photosensitive plate-making material; scanning the photosensitive plate-making material by using modulated laser light so as to record an image on the photosensitive plate-making material; and developing the image, wherein: the laser light includes ultra-short pulse laser light which causes

photopolymerization reaction by a two photon absorption phenomenon at a laser-light-irradiated portion of the photosensitive plate-making material.

【0008】

Also, a plate-making apparatus according to the present invention is a plate-making apparatus for scanning a photosensitive plate-making material by using modulated laser light to record an image on the photosensitive plate-making material, comprising: a light source for generating laser light including ultra-short pulse laser light which causes photopolymerization reaction by a two photon absorption phenomenon at a laser-light-irradiated portion of the photosensitive plate-making material; a light modulator; and a light scanning mechanism.

【0009】

The two-photon absorption phenomenon implies such a phenomenon that since a light absorption member absorbs two pieces of photon at the same time, such absorption may occur which is equivalent to energy (1/2 wavelength) two times higher than that of actually irradiated light. In this phenomenon, for instance, when femtosecond laser light having an infrared wavelength of 760nm is irradiated, such a light absorption occurs which is equivalent to irradiation of light having a UV wavelength of 380nm. It should be noted that the unit of "femto" is equal to 10^{-15}.

It should be understood that an occurrence probability of such a two-photon absorption phenomenon is very low, as

compared with that of a one-photon absorption phenomenon in the case that light having a general light intensity is irradiated. However, since the occurrence probability of the two-photon absorption phenomenon is directly proportional to a squared value of the irradiation light intensity, if the irradiation light intensity is increased so as to considerably increase the photon density, then the induction of the two-photon absorption phenomenon becomes active. In such a case that laser light is made of a ultra-short pulse laser, the photon density becomes very large, so that peak laser power higher than, or equal to $1kW/cm^2$ can be easily produced. In this case, the two-photon absorption phenomenon may occur in a practical level. Also, as previously explained, since the occurrence probability of the two-photon absorption phenomenon is directly proportional to the illumination light intensity, the two-photon absorption phenomenon may occur only at a focal position where laser light is focused. It should be noted that, in the present invention, the two-photon absorption phenomenon comprehends a multiple-photon absorption phenomenon wherein more than three photons are absorbed to a light absorption member.

【0010】

According to the present invention, such a photosensitive material can be employed based upon the basic idea of the two photon absorption phenomenon. This photosensitive material owns such a sensitivity with respect to light having a wavelength equal to a half (otherwise shorter

than 1/2) of the wavelength of the irradiation laser light. In other words, such laser light having the wavelength two times longer than the photosensitive wavelength of the photosensitive material can be employed. As a consequence, the adverse influences of the laser flares which are caused by the diffraction and scattering phenomena of the laser light can be mitigated, which may especially cause a serious problem when the laser light having the short wavelength is employed. Accordingly, the following problems can be considerably solved in the non-image formed portion in the recorded image, or the recorded plate-making material. As to these problems, there are colors and films remained in the non-image formed portion, dirty portions of the plate material, thickening of halftone dots and lines, and fringes around the halftone dots.

Also, as explained above, since the occurrence probability (absorption amount) of, for example, the two-photon absorption phenomenon is directly proportional to the squared light intensity, the focal point of the laser light can be narrowed, so that the two photon absorption phenomenon may occur only the area in the vicinity of this focal point so as to expose the photosensitive material. As a consequence, the high resolution can be achieved.

【0011】

In the present invention, it is desired that a pulse width of the above-described ultra-short pulse laser is not longer than 10ps. By exposing the photosensitive

plate-making material by using a ultra-short pulse laser light having a pulse width of femtosecond order (a hundred - several hundred fs to severarl ps), it is possible to obtain high peak power easily. Accordingly, while the photosensitive material is not influenced by the thermal adverse effect at all, the photosensitive material can be exposed so that the edge portions between the exposed portion and the unexposed portion become sharp. Thus, the image having higher resolution can be recorded.

【0012】

In the present invention, it is desired that a wavelength of the above-described ultra-short pulse laser is not longer than 800nm, and a photosensitive wavelength of the above-described photosensitive plate-making material is not longer than 800nm.

【0013】

The photosensitive plate-making material used in the present invention is formed in such a manner that a photosensitive layer made of photopolymer is formed on a base plate. In generally, photopolymer has a photosensitive wavelength of 400nm or shorter (namely, ultraviolet exposure range). Such photopolymer having a ultraviolet exposure range shows low sensitivity to visible light. As a consequence, the photopolymer can be exposure-processed in a light room, or a semi-light room (for example, a room wherein light having wavelengths higher than or equal to yellow wavelength is employed as illumination light), so that the processing

efficiency of this photopolymer can be largely improved.

【0014】

Photopolymer implies a macromolecular which is changed from monomer to polymer by being irradiated by light. Normally, photopolymer corresponds to such a substance made by adding a sensitizer or polymerization starting agent to monomer having photopolymerization property, prepolymer (namely, dimmer, trimmer, and oligomer) having photopolymerization, or mixtures of these monomer and prepolymer, and copolymer made of these monomer, prepolymer, or mixture (will be referred as representative name "photopolymerization compound" hereinafter). Photopolymer photosensitive material is formed in such a manner that photopolymer layer is formed on a base made of aluminum etc.

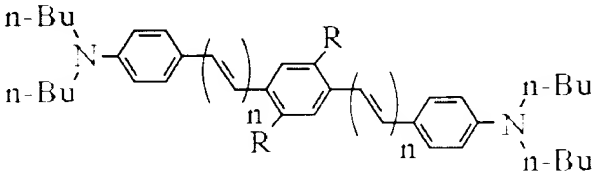
In particular, as a suitable photopolymerization compound, for instance, an ester containing an unsaturated carboxylic acid and an aliphatic polyhydric alcoholic compound, and an amide containing an unsaturated carboxylic acid and an aliphatic polyhydric amine compound can be mentioned. With respect to detailed description as to such photopolymerization compounds and the sensitizer, the polymerization starting agent, the binders and other additional subjects used in combination with the photopolymerization compounds, and the supporting members, JP-A-5-164982 may constitute proper references.

【0015】

As another useful photopolymer, such a system which

contains π conjugated compound having a high sensitivity of two-photon absorption phenomenon as a photo-initiator may be employed. This useful photopolymer is described in WO-98-21521, WO-99-53242, Compston et al, "Two-photon polymerization initiators for three-dimensional optical data storage and microfabrication", Nature, vol. 398, March 4, 1999, pp. 51-54. Concretely speaking, the below-mentioned photopolymer composition may be coated as a photosensitive layer on a supporting member made of aluminum or other materials to produce the photosensitive plate to be used in the present invention. The photopolymer composition contains a polymer binder, polymerizable acrylate monomer and D-π-D compound. The following chemical formula shows such a typical D-π-D compound. In this compound, symbol "D" indicates either low ionizing potential atom or a low ionizing potential atom group, which can be coupled to a π conjugated bridge.

【Chemical Formula 1】



8: R=-OMe,n=1
9: R=-OMe,n=2

【0016】

As the ultra-short pulse laser source, such light sources, for example, a mode-lock $Ti:Al_2O_3$ laser, a femtosecond fiber laser wherein an Er-doped fiber is used, a CPM laser wherein a pigment is used, or the like can be employed.

【0017】

Referring now to drawings, various preferred embodiments of the present invention will be described in detail.

Fig. 1 is a flow chart for describing a plate-making method according to the present invention.

Fig. 2 is diagram for schematically indicating a treatment process of a photosensitive plate-making material made by the plate-making method as shown in Fig. 1.

Referring to Fig. 1, at step S1, image information is stored in a computer. In this operation, an original image is optically read by using a scanner, or CAD (computer-aided design) information as well as electronic photographic information is received so as to be stored in the computer.

【0018】

At step S2, a photosensitive plate-making material made of high sensitive photopolymer is prepared.

As indicated in Fig. 2(A), a photosensitive plate-making material 1 is formed as follows: A photopolymer layer 5 is formed on a base plate 7 made of aluminum, or resin, and an overcoat layer 3 is formed on this photopolymer layer 5. The overcoat layer 3 is made of polyvinyl alcohol or acid cellulose, etc. The function of this overcoat layer 3 can avoid such a fact that photopolymer is reacted with oxygen and the like contained in air to be thereby polymerized.

【0019】

At step S3 (see Fig. 1), the surface of the photosensitive

plate-making layer 1 is scanned in a two-dimensional manner by way of modulated laser light by employing a laser scanner (that will be explained later in detail as referring to Fig. 3, Fig. 4, and Fig. 5), so that an image is printed on this scanned photosensitive plate-making material 1. At this time, as indicated in Fig. 2(B), for instance, femtosecond laser light 9 having an infrared wavelength of 760nm is irradiated in such a manner that this laser light 9 is focused on the photopolymer layer 5. Then, this laser light 9 causes photopolymerization reaction to occur in the vicinity of this focal point in order that a selected portion within the photopolymer layer 5 is hardened (see hardened portion 11).

【0020】

At step S4, the printed photosensitive plate-making material 1 is developed by using a developing fluid which is made from a potassium silicate water solution, and is capable of melting an unhardened portion of the photosensitive layer. As a result, as represented in Figs. 2(B) and 2(C), both the overcoat layer 3 and the unhardened photopolymer layer 5 are removed, so that an image constituted by the hardened portion 11 is formed on the base plate (supporting member) 7. It should be noted in the normal printing plate, the hardened portion 11 constitutes a so-called "halftone dot gradation." It should also be noted that although the positive type photosensitive plate-making material is employed in the above-explained example, a negative type photosensitive plate-making material may be apparently employed in the

plate-making method of the present invention.

【0021】

At step S5, the photosensitive plate-making material 1 is cleansed by using water so as to wash the developing fluid and the like.

At step S6, this photosensitive plate-making material 1 is treated by way of the rinse process by using a water solution containing surface active agent or by way of the desensitization process by using gum fluid. Alternatively, both the rinse process and the desensitization process may be employed.

The compositions as to the above-described developing fluid, rinse fluid, and gum fluid used in the desensitization process, and further the above-explained developing apparatus are known in this technical field, for example, in Japanese Patent Publication JP-B-7-13740.

【0022】

As to the planographic printing plate manufactured in the above-explained manner, the hardened portion 11 of photopolymer represents a high lipophilic property, and the remaining portion 13 represents a hydrophilic property. In the subsequent printing stage, wetting water is applied to the printing plate 1 and ink is applied to the hardened portion 11. This ink may be directly transferred to a paper to be printed, or may be transferred via a blanket body to a paper to be printed so as to print the image on the paper.

【0023】

Next, an image recording apparatus for printing image information on a photosensitive plate-making material is will now be explained with reference to Fig. 3 to Fig. 5. It should be understood that "upper", "lower", "left", and "right" directions represent directions in the respective drawings in the below-mentioned specification.

Fig. 3 is a perspective view for schematically indicating a construction of an inner drum type plate-making image recording apparatus according to an embodiment of the present invention.

In this image recording apparatus 21, the photosensitive plate-making material 1 is attached to an inner surface of a drum 35 having a cylindrical inner surface. This drum 35 is driven by a drum moving mechanism 37 to be moved along a Z direction shown in this drawing (namely, direction along drum shaft center).

【0024】

An optical system 22 of this image recording apparatus 21 contains a laser light source 23 and 25, AOM (acousto-optic modulation element) 27, a collective lens 29, and a rotary mirror 31. The LD-excited green solid-state laser light source 23 arranged at an end of the optical system 22 emits excitation-purpose laser light toward the $Ti:Al_2O_3$ laser light source 25 arranged next to the light source 23. This $Ti:Al_2O_3$ laser light source 25 is equipped with a mode lock mechanism (not shown), and oscillates such laser light having a very short (ultra-short) pulse width defined from 100fs to 300fs.

The wavelength sweep range of the laser light source 25 may be 700nm to 900nm. As the assemblies of the laser light sources 23 and 25 which are provided with such a mode lock mechanism and such a wavelength sweep mechanism, for instance, the laser assembly named "Tsunami" marketed by SPECTRA PHYSICS cooperation may be employed.

【0025】

The ultra-short pulse laser emitted from the $Ti:Al_2O_3$ laser light source 25 is entered into the AOM 27 which may externally modulate laser light. This AOM 27 includes a transducer, a crystal body (both of them are not shown), and the like.

The crystal body corresponds to an ultrasonic medium. In response to ultrasonic waves produced from the transducer, density variations occur in this crystal body, and thus, the density variations of this crystal body is utilized as diffraction grating. This crystal body projects the incident laser light along a direction at an angle corresponding to order number of this diffraction. The first-order diffraction light for the printing operation, which is derived from the AOM 27, is traveled along the direction of the collective lens 29. In other words, a selection is made as to whether or not the laser light for the printing operation is projected to the direction of the collective lens 29 by controlling a voltage applied to the transducer of the AOM 27.

【0026】

The first-order diffraction light traveled from the AOM 27 is converged by the collective lens 29. As previously explained, the convergence focal point is adjusted to be positioned on the photopolymer layer 5 (see Fig. 2(B)) of the photosensitive plate-making material 1.

【0027】

The laser light derived from the collective lens 29 is entered into a rotary mirror 31. The rotary mirror 31 is rotated in a high speed by receiving drive force given from the motor 33 around the same shaft as the shaft center of the plate-making material drum 35. A plane of the rotary mirror 31 on the side of the collective lens 29 constitutes such a plane which is inclined by 45 degrees with respect to the shaft center. The laser light which impinges on this plane is deflected toward the surface of the photosensitive plate-making material 1. The position of the laser light which impinges on the photosensitive plate-making material 1 is varied, depending upon the rotation of the rotary mirror 31, so that the laser light is scanned along the X direction as shown in this drawing. It should also be noted that since the photosensitive plate-making material 1 is scanned in combination with the drum 35 along the Z direction, the photosensitive plate-making material 1 is scanned by the laser light in the two-dimensional manner in conjunction with the deflection scanning operation of the laser light.

【0028】

In the image recording apparatus of Fig. 3, the

femtosecond laser light having the infrared wavelength of 760nm, which is emitted from the Ti:Al_2O_3 laser light source 25, is external-modulated by the AOM 27, and then the modulated laser light is traveled via the collective lens 29 and the rotary mirror 31 so as to scan the surface of the photosensitive plate-making material 1. Thereafter, this modulated laser light is focused onto the photopolymer layer 5 (see Fig. 2(B)) formed on the photosensitive plate-making material 1. At this time, a two-photon absorption phenomenon occurs, so that chemical changes (photopolymerization reaction) corresponding to the absorption of UV wavelength of 380nm occur.

【0029】

Fig. 4 is a perspective view for schematically showing an outer drum type plate-making image recording apparatus according to an embodiment of the present invention.

In this outer drum type plate-making image recording apparatus, an optical system 52 is the same as the optical system 22 of the inner drum type image recording apparatus as shown in Fig. 3, except that both the rotary mirror 31 and the motor 32 indicated in Fig. 3 are not employed in this outer drum type image recording apparatus. In this image recording apparatus of Fig. 4, since two series of such an optical system 52 are provided, a shortage of image drawing speeds can be compensated.

【0030】

In the image recording apparatus as shown in Fig. 4,

the photosensitive plate-making material 1 is attached, or adhered to an outer surface of a drum 55 having a cylindrical outer surface. This drum 55 is rotated along the X direction as shown in this drawing by a rotation mechanism 57 containing a motor or a reduction gear, etc.

Two series of these optical systems 52 emit laser light along two fixed directions, and then two sets of laser light are focused onto the surface of the photosensitive plate-making material 1. While an image is recorded on this photosensitive plate-making material 1, the entire unit of the optical systems 52 is scanned along the Z direction of this drawing (namely, direction parallel to shaft center of drum 55). As a result, the entire surface of the photosensitive plate-making material 1 is scanned by the laser light in the two-dimensional manner by rotating the drum 55 along the X direction and by scanning the optical system 52 along the Z direction.

【0031】

Fig. 5 is a sectional view for schematically indicating a construction of an automatic plate-making apparatus according to an embodiment of the present invention. This plate-making apparatus includes a flat bed type image recording unit for plate-making use.

As shown in Fig. 5, an internal space within this automatic plate-making apparatus 110 is subdivided into three layers. In these three layers, a reading unit 114, an image recording unit 116, a plate-making material processing unit

118, and a data acquiring unit 160 are arranged in this order from the upper layer to the lower layer. While an original "T" is positioned on an original plate 120 provided on an upper surface of this plate-making apparatus 110, either the image formed on this original "T" on an image entered from the computer 112 is recorded on the photosensitive plate-making material 1 (either film photosensitive plate-making material or paper photosensitive plate-making material) so as to form either a film plate or a paper plate.

【0032】

The original plate 120 is mounted at a position substantially same as a central position of an upper surface of a main body of this automatic plate-making apparatus 110. After the original "T" is set onto the original plate 120, this original "T" is depressed by an original cover 122. A condition input unit 124 is mounted on the left side of the upper surface of the above-described main body. This condition input unit 124 is used to enter various process conditions by an operator. These process conditions are related to the various reading and output process conditions, for instance, an image reading range and an output image magnification of the original "T", and specific process conditions such as trimming process and grain process. After these conditions are input via the condition input unit 124 and the original "T" is mounted on the original plate 120, the operator pushes a start switch (not shown) and then the image reading operation of the original "T" is commenced by

the reading unit 114.

【0033】

When the start switch is thrown by the operator, while a reading light source 126 employed in the reading unit 114 of this automatic plate-making apparatus 110 is moved along a direction indicated by an arrow "a" (namely, direction parallel to lower surface of original plate 120), this reading light source 126 irradiates reading light to the original "T" so as to scan this original "T". A mirror 128 is positioned under the reading light source 12, and a mirror unit 130 is positioned on the right side of this mirror 128.

【0034】

The mirror 128 is transported in synchronism with the reading light source 126 in such a manner that this mirror 128 is always located under this reading light source 126. The mirror unit 130 is transported along the same direction as the transport direction of the reading light source 126 at a half speed of the transport speed of this reading light source 126. The reflection light from the original "T" is reflected on the mirror 128 and the mirror unit 130, and thereafter, is reached to a focusing lens 136.

【0035】

The focusing lens 136 may adjust the focal distance of the reflection light from the mirror unit 130. A CCD sensor 138 is arranged on the left side of this focusing lens 136. This CCD sensor 138 optically reads out the light whose focal distance has been adjusted, and then photoelectrically

converts this read light so as to acquire the image information of the original "T".

【0036】

An image information processing apparatus 140 is arranged on the left side of the CCD sensor 138. Either the image information (namely, image of original "T") derived from the CCD sensor 138 or image information supplied from a computer 112 is entered to this image information processing apparatus 140. In response to the input condition of the condition input unit 124, the image information processing apparatus 140 processes the image information entered from either the CCD sensor 138 or the computer 112 so as to produce halftone dot image information. This image information processing apparatus 140 is connected to the data acquiring unit 160.

【0037】

The image recording unit 116 of this automatic plate-making apparatus 110 conducts the flat bed scanning type image recording unit, and records the image on the photosensitive plate-making material 1. A driver 141 of the image recording unit 116 receives the halftone dot image information entered from the image information processing apparatus 140, and then drives an exposure light source 142 in accordance with this halftone dot image information. The exposure light source 142 is arranged by an LD-excited green solid-state laser light source, a $Ti:Al_2O_3$ laser light source, an AOM, and a collective lens, which are not shown in this

drawing, similar to the above-explained example as shown in Fig. 4. This exposure light source 142 emits recording light (laser light) 9 produced based upon the halftone dot image information toward a resonant scanner 144.

【0038】

The resonant scanner 144 corresponds to a so-called "optical deflector", and deflects the laser light 9 emitted from the exposure light source 142 along a main scanning direction (namely, vertical direction as viewed in drawing plane of Fig. 5). An "Fθ" lens 146 is arranged on the right side of the resonant scanner 144. This "Fθ" lens 146 may adjust a focal position of the laser light 9 from the resonant scanner 144 so as to focus the laser light 9 onto the photosensitive plate-making material 1.

【0039】

On the right side of the image recording unit 116, the photosensitive plate-making material 1 is wound in a roll shape which is stored in a magazine 150. The photosensitive plate-making material 1 is pulled out from the magazine 150, and is held at a predetermined exposure position by the exposure drum 152. While this photosensitive plate-making material 1 is maintained at this exposure position, this material 1 is transported by this exposure drum 152 and nip rollers 154 and 156 along a lower direction, namely the sub-scanning direction which is substantially perpendicular to the main scanning direction. Since the laser light 9 is scanned along both the main scanning direction and the sub-scanning

direction, the entire surface of the photosensitive plate-making material 1 is scanned by this laser light 9 in the two-dimensional manner, so that such an image is recorded on the scanned photosensitive plate-making material 1 in response to the halftone dot image information acquired by the image information processing apparatus 140.

【0040】

After the photosensitive plate-making material 1 on which the image is recorded is cut by a cutter 158 by a predetermined length, the cut photosensitive plate-making material 1 is transported to a plate material processing unit 118. The photosensitive plate-making material 1 which is transported to the plate material processing unit 118 is processed through steps which are determined in accordance with the sort of the photosensitive plate-making material 1. Thereafter, the processed photosensitive plate-making material 1 is ejected onto a tray (not shown). For instance, in the case that a silver halide photographic photosensitive material is employed as this photosensitive plate-making material 1, this silver halide photographic photosensitive material is processed by a developing step, a bleaching/fixing step, a water cleansing step, and then, a drying step. Thereafter, the processed photosensitive material is ejected to the tray.

It should be noted that a detail of the material processing unit 118 is not shown in Fig. 5 to simplify the drawing.

【0041】

It should be understood that the plate-making apparatus according to the present invention is not limited to such an automatic plate-making apparatus as shown in Fig. 5, but also may be applied to all of plate-making apparatuses for making such printing plates, for example, PS plates, silver halide photographic plates, and electronic photographic plates. Also, the present invention may be applied to all of plate-making apparatuses to which various sorts of plate-making materials are applied.

【0042】

【Effects of the Invention】

As previously explained, according to the present invention, since the laser light having the ultra-short pulse width is employed in the exposure process operation, the photosensitive plate can be formed by employing the photosensitive material having such a sensitivity sensible to such light having a wavelength shorter than, or equal to a half wavelength of the irradiation laser light. As a result, the adverse influences caused by the laser flares can be hardly given to this plate-making method/apparatus, so that the following problems can be largely solved in the non-image formed portion in the recorded images or the recorded plate-making material, and also the image can be readily obtained in high resolution. As to the above-explained problems, there are colors and films remained in the non-image formed portion, dirty portions of the plate material,

thickening of halftone dots and lines, and fringes around the halftone dots.

【0043】

In the case where the pulse width of the ultra-short pulse laser is made narrower than or equal to 10ps, while the photosensitive material is not influenced by the thermal adverse effect at all, the photosensitive material can be exposed so that the edge portions between the exposed portion and the unexposed portion become sharp. Thus, the image having higher resolution can be recorded.

【0044】

In the case where the wavelength of the ultra-short pulse laser is selected to be 800nm or shorter and the photosensitive material having photosensitive wavelength of 400nm or shorter is used, the exposure-processing can be carried out in a light room or a semi-light room, so that the workability can be greatly improved.

【Brief Description of the drawings】

【Fig. 1】

Fig. 1 is a flow chart for describing a plate-making method according to an embodiment of the present invention.

【Fig. 2】

Fig. 2 is diagram for schematically indicating a treatment process of a photosensitive sensitive plate-making material made by the plate-making method as shown in Fig. 1.

【Fig. 3】

Fig. 3 is a perspective view for schematically representing a structure of an inner drum type plate-making image recording according to an embodiment of the present invention.

【Fig. 4】

Fig. 4 is a perspective view for schematically representing a structure of an outer drum type plate-making image recording apparatus according to an embodiment of the present invention.

【Fig. 5】

Fig. 5 is a sectional view for schematically representing an arrangement of an automatic plate making apparatus including a flat bed type image recording unit, according to an embodiment of the present invention.

【Explanation of Reference Numerals】

1 ... Photosensitive plate-making material

1' ... Printing plate

3 ... Overcoat layer

5 ... Photopolymer layer

7 ... Base plate

9 ... Laser light

11 ... Hardened portion

13 ... Rubber film

21, 51 ... Image recording apparatus

22, 52 ... Optical system

23 ... LD-excited green solid-state laser light source

25 ... Ti:Al_2O_3 laser light source

27 ... AOM(acousto-optic modulating element)

29 ... Collective lens

31 ... Rotary mirror

33 ... Motor

35, 55 ... Drum

37 ... Drum moving mechanism

57 ... Rotation mechanism

110 ... Plate-making apparatus

112 ... Computer

114 ... Reading unit

116 ... Image recording unit

118 ... Plate-making material processing unit

120 ... Original plate

122 ... Original cover

124 ... Condition input unit

126 ... Reading light source

128 ... Mirror

130 ... Mirror unit

136 ... Focusing lens

138 ... CCD sensor

140 ... Image information processing apparatus

141 ... Driver

142 ... Exposure light source

144 ... Resonant scanner

146 ... F() lens

150 ... Magazine

152 ... Exposure drum

154, 156 ... Nip roller

158 ... Cutter

160 ... Data acquiring unit T ... Original

【Document Name】 Abstract

【Abstract】

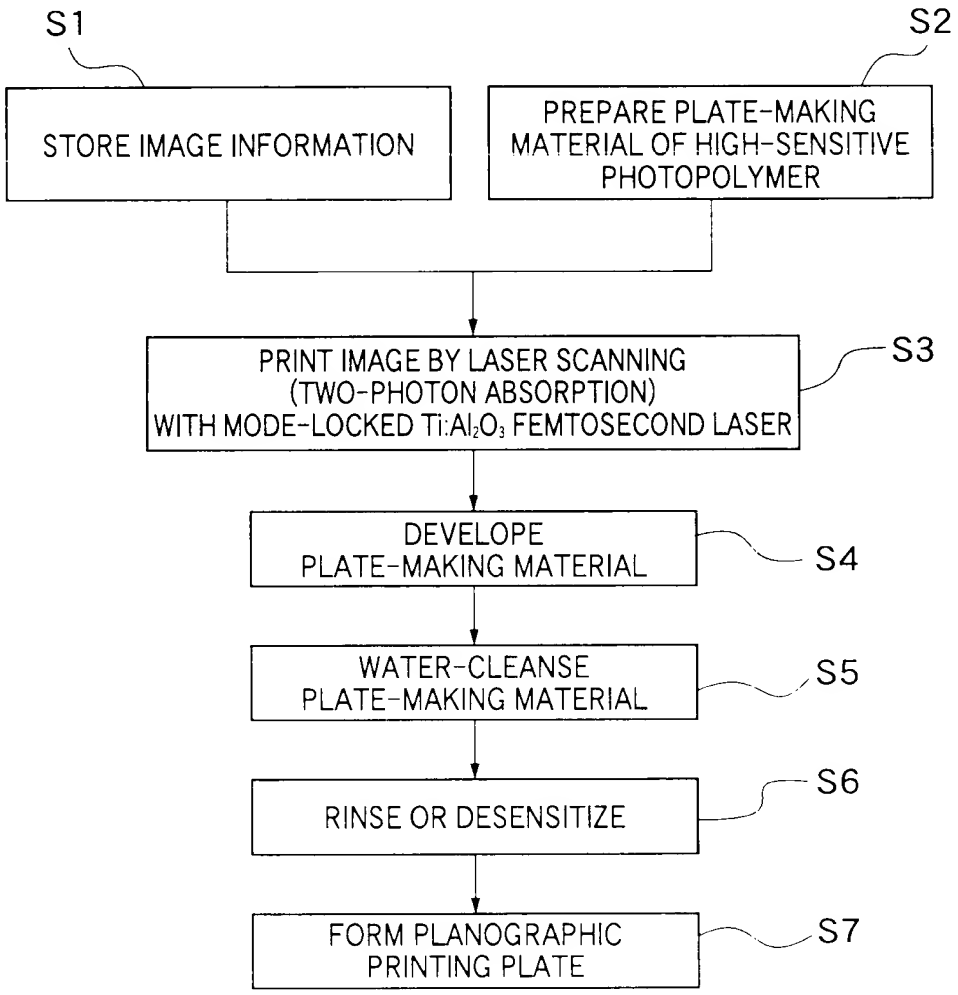
【Problems to be Solved】 To provide a plate-making method etc. capable of recording a sharp image on a photosensitive plate while adverse influences caused by laser flares can be hardly received, and is applicable to a process operation executed in a light room,

【Means for Solution】 Ultra-short pulse laser light emitted from a $Ti:Al_2O_3$ laser light source 25 (Fig. 3) is modulated by an AOM 27 (acousto-optic modulating element). The modulated laser light is focused by a collective lens 29 onto a high-sensitive photopolymer layer 5 (Fig. 2) of a photosensitive plate-making material 1. The focused ultra-short pulse laser light may cause a photopolymerization reaction in a laser-light-irradiated portion of the photopolymer layer 5 by way of a two photon absorption phenomenon, so as to form a hardened portion 11.

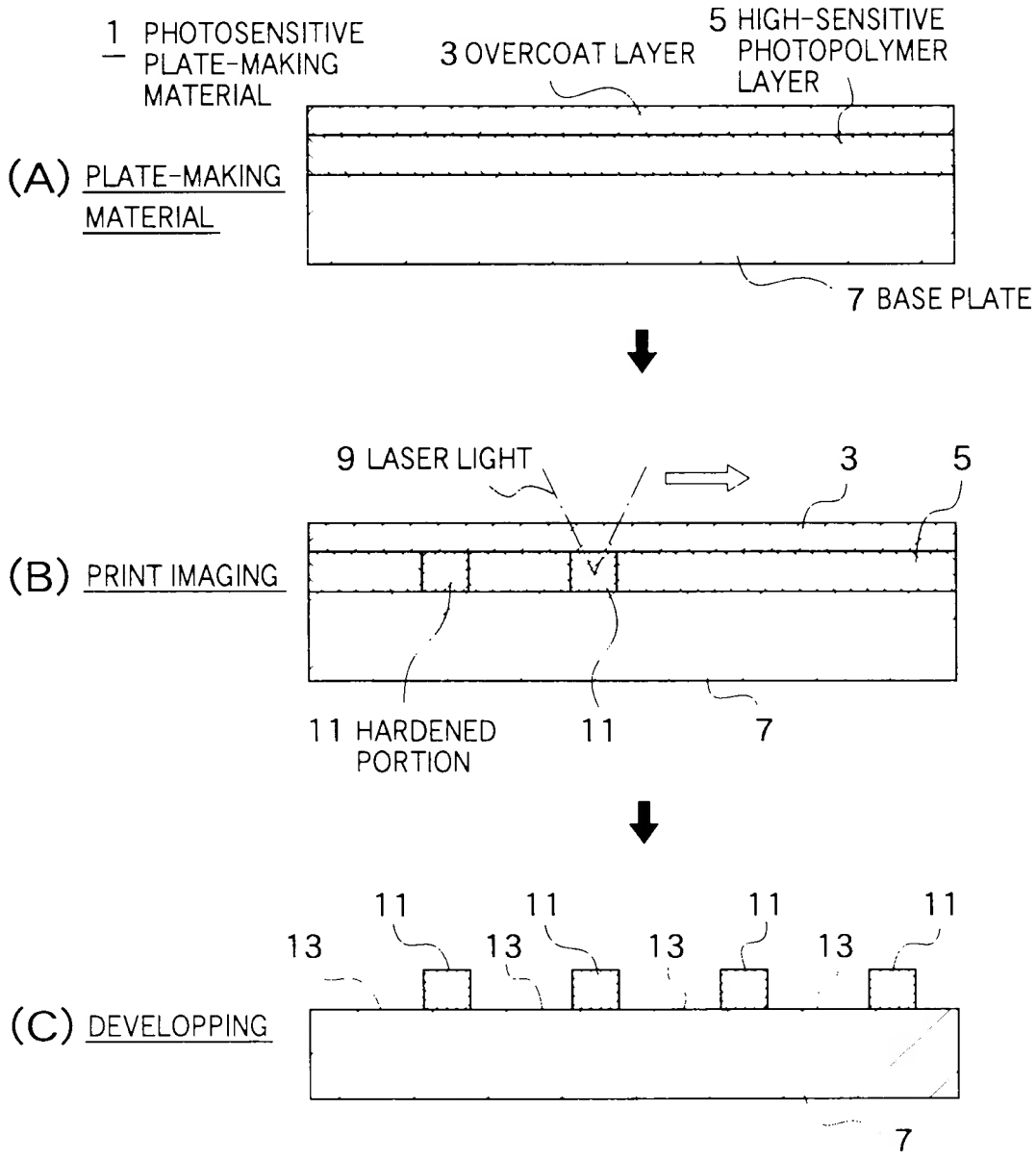
【Selected Drawing】 Fig. 2

【DOCUMENT NAME】 DRAWINGS

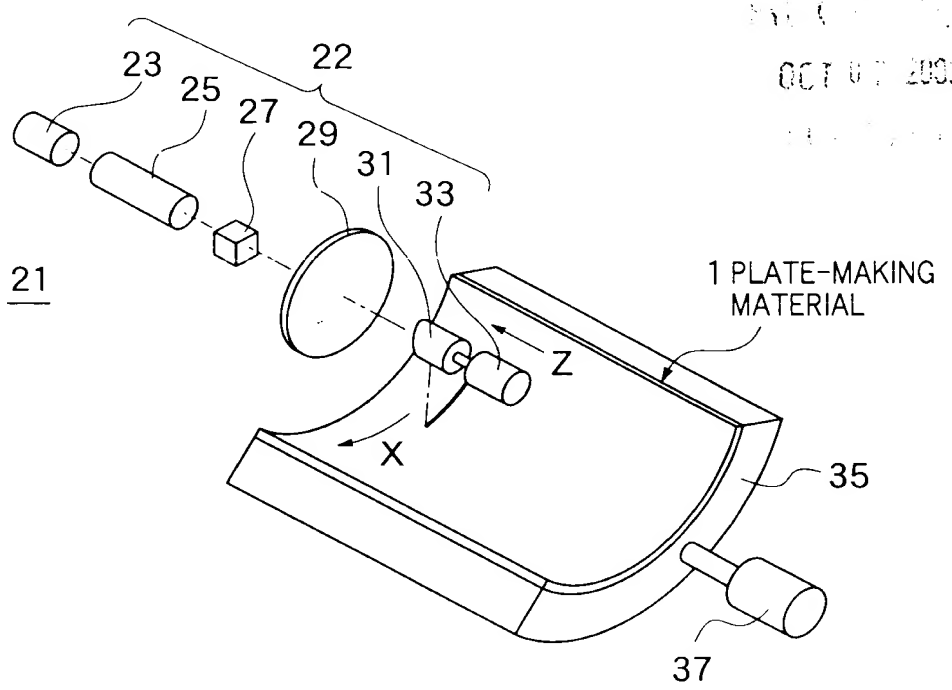
【FIG. 1】



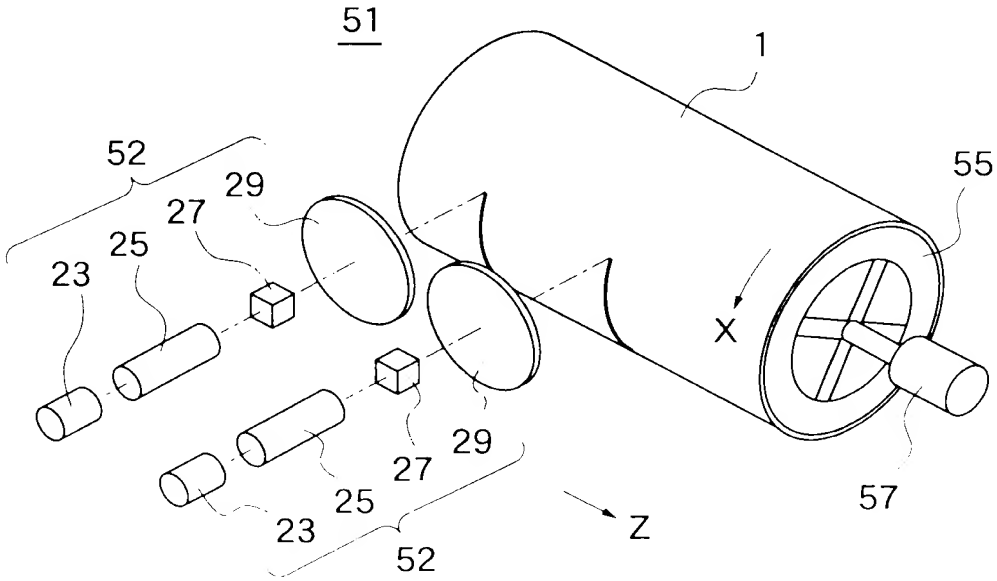
【FIG. 2】


1 PHOTOSENSITIVE PLATE-MAKING MATERIAL
3 OVERCOAT LAYER
5 HIGH-SENSITIVE PHOTOPOLYMER LAYER
(A) PLATE-MAKING MATERIAL
7 BASE PLATE
9 LASER LIGHT
3
5
(B) PRINT IMAGING
11 HARDENED PORTION
11
7
11
11
11
11
13
13
13
13
(C) DEVELOPPING
7

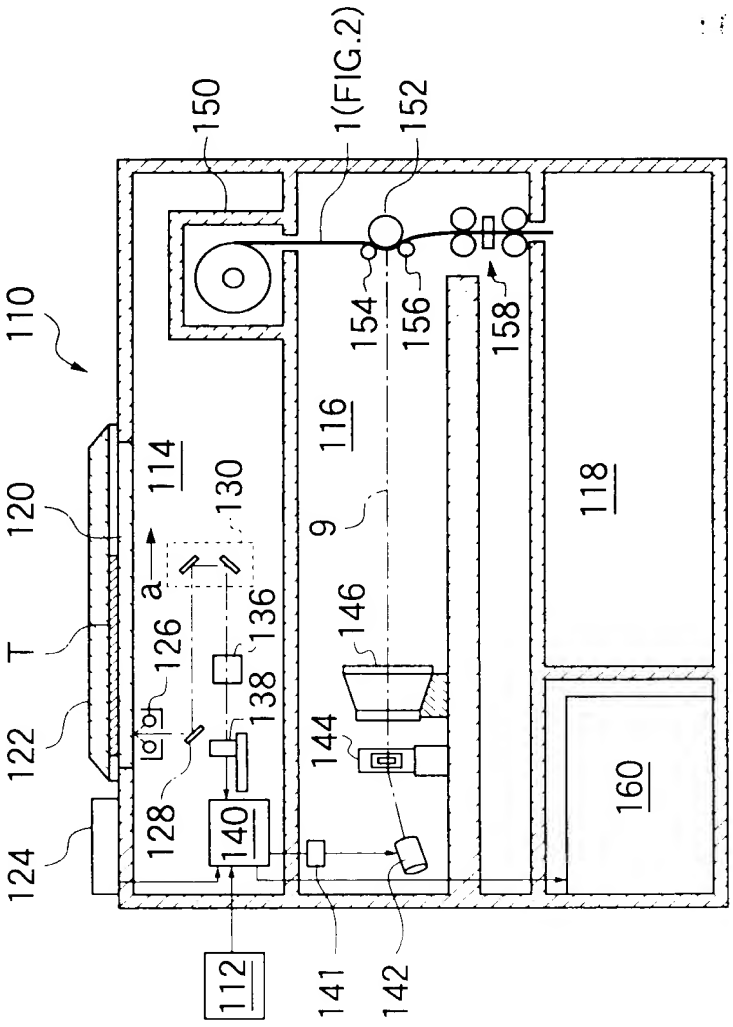
【FIG. 3】


22
23
25
27
29
31
33
21
1 PLATE-MAKING MATERIAL
Z
X
35
37

【図 4】


51
1
52
55
29
27
25
23
X
29
27
25
23
52
Z
57

【FIG. 5】


1(FIG.2)
150
152
110
154
156
158
116
114
130
120
9
118
a
146
T
126
136
138
122
144
128
140
160
124
112
141
142